

NASA TECH BRIEF



NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Thermally Conducting Electron Transfer Polymers

The problem:

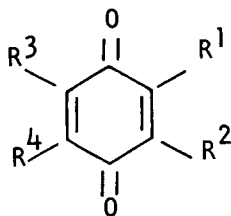
Recent developments in electronic circuitry, such as subminiaturization of components and modular construction of circuits, have generated serious problems in the areas of environmental protection, mechanical shock, radiation, and temperature. Certain potting compounds have afforded good mechanical shock and radiation protection but have acted as thermal insulators due to poor heat conductivity. This has resulted in degraded performance and in catastrophic failure in some instances.

The solution:

New polymeric materials that exhibit excellent physical shock protection, high electrical resistance, and outstanding thermal conductivity. They may be classed as substituted quinhydrone polymers in which any difunctional compound, having as its functional group an amine, a halogen, a mercaptan group, a hydroxyl, a carbonyl, and compounds having an active hydrogen atom, among others, reacts with a quinone.

How it's done:

An exemplary general compound found to yield the above-cited benefits is:



R^1 , R^2 , R^3 , R^4 may all be hydrogen or may be various substituents such as halides, methoxy, secondary amines, alkyl, alkene, aromatic rings, heterocyclic rings either singly-bonded or fused to the quinone ring, among other compounds. The second reaction intermediate may be compounds containing a labile hydrogen such as N,N^1 -dimethyl-1, 6-hexanediamine, 1, 8-octanediamine, piperazine, dithiols, diacidhalides, diol (aliphatic, heterocyclic or aromatic), in addition to silanes, silanediols, silane dihalides, phosphines, phosphorus halides, and other reactive difunctional compounds.

These polymers are formed by substitution of the reactive ring substituent by the amine groups. In some cases the quinone is reduced to the hydroquinone and may be reoxidized by using an excess of the initial quinone compound through the formation of strong charge transfer complexes.

Wherein most organic polymers have a thermal conductivity in the range of $2-4 \times 10^{-4}$ cal/cm-sec- $^{\circ}$ C, this new class of polymers is found to have a thermal conductivity in the range of $1.5-3 \times 10^{-3}$ cal/sec- $^{\circ}$ C. Furthermore, where many charge-transfer polymers have electrical resistivities in the order of $10^5 - 10^7$ ohm cm, the above-mentioned polymers have a resistivity of $10^{10} - 10^{12}$ ohm cm.

Note:

No further documentation is available. Inquiries may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland 20771
Reference: B69-10511

(continued overleaf)

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Robert K. Jenkins, Norman R. Byrd,
and James L. Lister of
McDonnell Douglas Corporation
under contract to
Goddard Space Flight Center
(GSC-10703)